
# ISSD NEWSLETTER

Volume III Number 3 Sept. 1990

# International Society for the Study of Dendrobatid Frogs

# I S S D

A general statement of some of the goals and objectives of ISSD:

## ISSD exists to:

: To encourage, stimulate, and wherever possible, facilitate scientific research as it relates to any and all aspects of the study of Dendrobatid frogs; including, but not limited to, ecological studies, toxicological studies, taxonomic studies, and studies concerned with husbandry and captive propagation.

: To unify those individuals who participate in these studies and to provide vehicles of communication for the dissemination of knowledge gained as a result of this research.

: To afford those individuals who participate in programs of captive propagation the opportunity to develop a breeders network to facilitate breeding loans and species trades.

: To assist those individuals who need, or desire, to communicate with foreign government agencies which control access to wild populations of Dendrobatids in countries where they exist naturally.

: To encourage uniformity in record keeping systems for captive propagation programs, as well as uniformity in methods of wild captured specimen disposition reporting.

: To encourage preservation of, and protection for, populations of threatened or endangered Dendrobatid species; while at the same time preserving opportunities for limited access to those populations by individuals with legitimate research interests.

: To encourage the establishment and maintenance of stable and genetically diverse captive populations of endangered or threatened species.

# Notes from the Editors

Again we are calling for articles, photographs, or anything of interested to our hobby of keeping dendrobatid frogs. If this Newsletter is to continue we need a steady supply of material to publish. With only about 150 members everyone needs to contribute something every other year to keep this publication going. If you haven't contributed previously now is the time.

It has been suggested that we change the name of our publication to the Bulletin of the International Society for the Study of Dendrobatids. It was suggested that a newsletter brings to mind a few mimeograph sheets stapled together, while our publications has expanded beyond that. The Random House College Dictionary defines a newsletter as "a written report, prepared by or for a group or institution, to present information...", while it defines a bulletin as "a periodical publication as of a learned society." I would prefer to think of ourselves as the latter. But the subject is now open to discussion, please send any comments to either Newsletter editor (Terry Chatterton, 8007 Ridge Rd., Arvada, CO. 80002 USA; or Charles Powell, II, 2932 Sunburst Dr., San Jose, CA 95111 USA). If no comments are forthcoming the change will take place with the first issue of volume 4.

*Dendrobates tinctorus* (Schneider) Photo. by Dale Bertram

This beautiful form of *D. tinctorus* was collected by Dale Bertram during a recent trip to French Guiana.

The name *D. tinctorus* has been applied to nine species in two genera (Silverstone, 1975) over the 190 years since its original description. As now defined *Dendrobates tinctorus* is a member of the *tinctorius* group which includes *D. auratus, D. azureus, D. glactonotus, D. tinctorius*, and *D. truncatus* (Silverstone, 1975). This species shows many different color patters (see Silverstone, 1975, fig. 15; ISSD Newsletter, 3(1): 19 (this figure shows a form collected from Table Mountain in Surinan) for another form), although there are generally a limited number of variably (continue on page 72)

# Captive maintenance and propagation of poison-dart frogs (Anura: Dendrobatidae) at the National Aquarium in Baltimore.[1]

by John F. Cover, Jr., and Anthony P. Wisnieski

1 printed with permission of the American Association of Zoological Parks and Aquariums AAZPA, 1989 Annual Conference Proceedings, Pittsburg, PN, 24-28 September, pp. 465-472.

## Introduction

The neotropical frog family, Dendrobatidae, is comprised of over 117 species and occurs from Nicaragua to southeastern Brazil and Bolivia (Duellman and Trueb, 1986). The family has recently undergone taxonomic changes to bring the current number of genera to seven (Myers, 1987; Myers and Ford, 1986; Zimmermann and Zimmermann, 1988). Dendrobatids, in general, are small, diurnally-active frogs with unusual life histories (Myers and Daly, 1983; Weygoldt, 1987). Most species of poison-dart frogs produce defensive skin secretions and display bright "warning" colorations (Duellman and Trueb, 1986). Utilization of three species by Amerindians for poisoning blowgun darts has been documented (Myers, et al., 1978) and is the basis for the family's common name.

Since its opening on 8 August 1981, the National Aquarium in Baltimore (NAIB) has maintained and exhibited dendrobatid frogs. In 1983, efforts began to procure a well diversified collection, with 17 species

currently represented in the collection. After extensive renovation of our exhibit area, we focused our attention on captive propagation in the fall of 1987. To date, we have been successful with captive reproduction of 12 species of poison-dart frogs. These active, colorful frogs often demonstrate feeding, reproductive, and territorial behaviors while on display and are a major component of our "Hidden Life" exhibits.

**Material and Methods**

Our frogs are maintained in two separate rooms, the Hidden Life exhibit back-up room (21-27°C) and a smaller, slightly cooler room (18-24°C). Species and populations of species from higher altitudes are maintained in the cooler room.

Caging consists of various sized, all-glass aquaria ranging from 38 liters (51x25x32 cm) to 209 liters (122x32x53 cm) with screen lids and clear plastic containers (normally sold as food storage containers) ranging from 63 liters (56x36x30 cm) to 81.7 liters (57x37x37.5 cm) with screen, snap on, hinged lids. The basic cage substrate consists of 2-6 cm of washed pea gravel, topped with a layer of sheet moss and sloped to provide a shallow pool of water in one corner of the front edge of the tank. Live plants (Ertelt, 1988) and/or plastic plants provided cover and egg laying sites. Plastic hide boxes (15x10x5 cm), and the plastic bottoms removed from 2 liter disposable soft drink bottles (base diameter = 11 cm, height = 5.5 cm) inverted with an entrance hole cut in the side, are also supplied for hiding and egg deposition. Some species are maintained in tanks with undergravel filter and flowing recirculated water via canister-type filters.

All of our plastic tanks have drains located in the front left corners. Water drains out of the tanks through 1.5 cm diameter flexible Tygon® tubing. Drains

are open and closed by use of a plastic flow valve clamp. It is strongly recommended that tanks housing dendrobatids be provided with a drainage mechanism. We are currently installing drains in all our tanks to ease tank cleaning and removal of excess water accumulated through misting. Excess water must be removed from tanks without drains by siphoning, which is both time consuming and disruptive to the cage inhabitants. In tanks with drains, gravel is suspended on a "false bottom". This false bottom is made from plastic "egg crate" material (commercially used for fluorescent light diffusion) cut to fit the bottom of the tank. The egg crate sheet is placed on top of plastic bio-filer cylinders (2.5 cm high) evenly spaced to support the weight of the gravel. Next, a piece of fiberglass window screening is placed on top of the egg crate and the washed pea gravel is then placed over the screen. Our undergravel filters are made from the same material.

Lighting is provided by double fluorescent fixtures containing two Vita lights (Duro Test, 120 cm (4 ft)) or a Vita light and a black light (G.E., 120 cm (4 ft) F40BL) mounted directly over the cage. Additional lighting is provided through a skylight. Artificial lights are controlled by timers set for a photoperiod of 12 hours light and 12 hours dark. Lights in both rooms go on and off sequentially with overhead lights coming on first and going off last to simulate a dawn and dusk effect.

A humid environment (60-90% relative) is created by daily cage misting, an industrial size humidifier (warmer room), and an ultrasonic humidifier in the cooler room. When additional humidity is desired, i.e., to stimulate breeding, cages are covered with clear plastic wrap. Water entering the frog rooms goes through a bank of canister-type filters containing activated carbon

and is chlorine-free.

Diet consists of one-day to one-week old crickets, *Acheta* (approximately 60%) and flightless fruit flies, *Drysophila* (approximately 40%). All fruit flies (2 species) are reared in-house and about 1/4 of the crickets are hatched from eggs obtained from our adult feed crickets. After two days, the pans are pulled, covered with plastic wrap and replaced with fresh pans. Crickets being hatching in about two weeks at room temperature. This helps ensure that we have a constant supply of very small crickets are obtained from a commercial supplier.

Feed crickets are fed a nutritionally balanced commercial cricket diet (Zeigler Bros., Inc.) for a minimum of 24 hours prior to being fed to the frogs. Initially, feed crickets were dusted 2-3 times per week with a vitamin/mineral supplement consisting of 1 part Vionate (Rich-Health), 2 parts calcium phosphate, and 2 parts bone meal alternated with Nekton-Rep (Nekton), a commercial vitamin supplement. This was later adjusted to a sole application of the Nekton-Rep. The frogs are fed 3-7 days a week depending on age and species (younger frogs are fed daily).

Poison-dart frogs in our collection have primarily come from two sources, either field collected by staff or professional colleagues or from animal dealers. Frogs obtained from dealers have generally shown higher mortalities probably due to stress induced from shipping, crowed conditions, and food deprivation. Our lowest mortalities have occurred when overcrowding is minimized and feeding of specimens began soon after collection while still in the field.

Upon arrival, all frogs are placed in a quarantine situation and each animal is examined for nose rubs, skin lesions, injuries, etc., and treated accordingly. At this time, the frogs are usually

maintained in groups of 4-10 until they are stabilized. Thin specimens or active medical cases are housed individually and isolated from the rest of the group.

**Propagation**

Efforts to sex individuals are made soon after acquisition. Sexing dendrobatid frogs is more of an art than an exact science at this time. Some species do exhibit sexual dimorphism in front toe pad width, body shape, and throat coloration.

Front toe pad width appears to be greater in males than in females for some species. This dimorphism has been described by Polder (1973) for *Dendrobates auratus*, *D. azureus*, and *D. tinctorius*. Savage (1968) also describes broader toe disk in male *Minyobates (Dendrobates) minutus*. We have used toe pad width to sex *D. auratus, D. azureus*, and *D. tinctorius*. Toe pad width doesn't not appear to be dimorphic fro the genera *Phyllobates, Epipedobates* and some species in the genus *Dendrobates* (*D. granuliferus, D. histrionicus, D. lehmanni, D. pumilio*, and *D. speciosus*). Also, there may be some overlap in a specimen in the lower range of male toe pad width with a female in the higher range of female toe pad width. For these specimens, the characters of body shape and behavior should be examined.

Body shape appears to differ between sexes in adults of many species of dendrobatids. Generally, adult females tend to have a more rounded body appearance, when viewed from above, than adult males. The body of males tend to be slimmer and more parallel sided. This characteristic is most evident in *D. auratus, D. tinctorius*, and *Phyllobates vittatus* and is particularly evident when females are ovulating.

Coloration can also be used in sexing at least two species. In *D. speciosus* and some populations of *D. pumilio*

(Kitasako, 1967), the throat coloration of males is darker than than of females. However, our observations indicate that this coloration sometimes fades in captivity and is best examined in freshly caught specimens.

In all species, especially those that are not dimorphic, behavioral observations such as vocalizations (calling in males) and courtship behaviors can be useful in determining sex. Many dendrobatids are not shy about calling in captivity. We have found that placing groups of *Dendrobates granuliferus* and *D. histrionicus* in small containers during cage cleaning will often induce calling in males. Observations of courtship behavior, such as stroking, courtship "dances", and cephalic amplexus in *Epipedobates* and *Phyllobates* (Duellman and Treub, 1986), can also aid in sex determination.

Once sexes have been identified, frogs can then be set up for breeding. Ideally, specimens should be housed with one male and one female per cage (this is also useful for long-term genetic management). Egg cannibalism, courtship interference, and competition for egg laying sites can occur when many dendrobatids are kept in group situations. In some cases, we were not able to achieve breeding success until pairs were isolated from groups.

Size of breeding tanks and type of plants used in tanks varied according to species. Generally, most *Dendrobates, Epipedobates* and *Phyllobates* bred in small, 38 liter tanks (51x25x32 cm). Species that are oophages (species that rear their tadpoles by feeding them unfertilized "food eggs", such as *D. granuliferus, D. histrionicus, D. pumilio*, and *D. speciosus*) are set up in taller, 57 liter tanks (51x26x48 cm) to accommodate the bromeliads these species need for tadpole rearing.

A general technique to stimulate breeding for all species includes covering the screened lid of the breeding tank with clear plastic to raise the humidity levels to 80-100%. Equally important is the presence of proper egg deposition sites.

Plastic "breeding huts" (bottoms of 2 liter soft drink bottles) are placed over glass petri dishes containing a flat plastic leaf and a small amount of water (1-3 mm deep) to provide egg deposition sites. Live plants were also used for egg deposition for many species. Breeding huts are checked for eggs 1-3 times per week. Once eggs are discovered, they are either left in the cage for the frogs to tend or the entire petri dish is removed and replaced with another petri dish containing a plastic leaf and a small amount of water. The petri dish containing the freshly laid eggs is then placed in a plastic container (base diameter = 11 cm, height 6.5 cm) on top of a layer (2-3 cm deep) of wet filtered floss (to provide high humidity). The petri dish is placed on a slight incline so water will contact the lower edge of the egg mass. This container is covered with a clear plastic wrap and maintained at room temperature (21-27°F). One to two small holes are made in the plastic wrap for circulation. Development is monitored and infertile eggs are removed to avoid contamination of fertile eggs.

Upon hatching, the tadpoles are transferred via a plastic spoon to a tadpole rearing tank (92x46x47 cm). This system is a modified version of the one used at the Oklahoma City Zoo (Lockwood, 1988). The tadpoles are placed individually in numbered compartments (5.4x5.4x5.4 cm) in tadpole rearing trays (32.5x22x5.5 cm) containing 24 compartments each (made from plastic parts trays). Styrofoam strips are attached to each tray with silicone in order to provide buoyancy, such that the

trays are suspended with 3/4 of their height under the water surface. They float freely in the rearing tank, are open at the top and have a 5-cm hole covered with fiberglass screen (1.5x1.5 mm mesh) on the bottom of each compartment. In addition to providing water circulation, the screened holes allows feces and uneaten food to flow downward and out of the tray. The tadpole rearing tank is filtered like a standard aquarium set-up with 5-8 cm of pea gravel as a bottom substrate, an undergravel filter, and a canister-type filter (Magnum 330, Marineland). Lighting on these tanks is similar to that for the adult frogs.

Tadpole care using this system is minimal. Trays are removed daily from the tank and gently rinsed over a sink. After rinsing, the tadpoles are fed flake fish food (Tetra Marin). They also continually graze on algae growing on the trays. Initially, we reared all tadpoles individually in puddle bowls (base diameter = 7 cm, height = 5 cm). However, this was found to not only be labor intensive, but increased the possibility of larval trauma due to the requirement for daily removal for cleaning.

The tadpole rearing trays are especially useful for dendrobatid species whose larvae demonstrate cannibalistic tendencies (*D. azureus, D. auratus, D. tinctorius*). It is also valuable when individual records are desired on when different genetic lines need to be maintained.

During metamorphosis, when all four legs have developed, the tadpoles are moved, via a plastic spoon, to a 38 liter tank (51x25x32 cm) provided for that species and/or population, with a sloping gravel substrate (approximately 2/3 land, 1/3 water). Live and plastic plants and hide boxes or huts provide cover for the newly metamorphosed frogs. High

humidity also appears to be necessary for young frogs, therefore, most rearing tanks are partially covered with clear plastic to raise humidity. Diet consists of newly hatched crickets and apterous fruit flies. When fully metamorphosed (tail absorbed) and feeding, they are moved to tanks similar to those for the adults. Again, species and population integrity are maintained.

Species that are not cannibalistic during their larval stage (*Phyllobates*) are raised in groups in rearing tanks (76x31x32 cm) similar to the other rearing tanks, but with the tadpoles released directly into the tanks instead of being placed in the floating trays. In this set-up, daily care consists only of feeding tadpoles flake fish food. Sloping plexiglass ramps coated with an aquatapoxy paint/gravel mixture and suspended into the water provide a land area for metamorphosed frogs. The higher fecundity (5-26 eggs per clutch) exhibited by *Phyllobates* meant that our individual tadpole trays were quickly filled by them and was our main reason for initially exploring mass rearing in group situations.

Use of tadpole rearing tanks did not prove entirely satisfactory for all species (e.g., *Epipedobates anthonyi, E. espinosai*, and *E. tricolor*). We experienced high mortality of *Epipedobates* larvae in rearing tanks and those that did metamorphose, did so with a high incidence of spindly front legs (Vojt, 1986). The best method we found for propagating species in this genus is to leave the eggs in with the parent frogs and allow them to hatch and be transported by the male parent to a pool created in front of the tanks. Tadpoles reared in this manner are fed primarily on algae scrapings to avoid fouling the water with uneaten flake food (tadpoles reared in these situations have also been observed feeding on

drowned crickets and fruit flies from the adult feedings). We have also reared *D. reticulatus, P. lugubris*, and *P. vittatus* in the breeding tanks. This technique is very labor efficient with care consisting only of occasional water changes and removal of young frogs. Care must be taken to remove the young frogs before they reach adult size and become indistinguishable from their parents.

The last group that are propagated and reared differently from the previously described species are the oophages species (Zimmermann, 1986). To date, we have successfully propagated two species in this group, *D. pumilio* and *D. speciosus*. As mentioned earlier, frogs in this group are set up in tall aquaria similar to other frogs but with bromeliads mounted to vertically placed strips of cork bark. An "ideal" bromeliad is spineless, has leaves that grow more horizontally than vertically, and is able to tolerate the high humid, stagnant conditions needed to stimulate frog breeding (Ertelt, 1988).

Frogs in this oophages group have more complex life histories than other dendrobatids (Weygoldt, 1980; Zimmermann and Zimmermann, 1981). Tadpoles of oophages species feed only on unfertilized food eggs produced by the female parent frog that periodically returns to the bromeliad holding her tadpoles and feeds them. Initially, we attempted to hand rear tadpoles from these species by feeding them raw chicken egg yokes using the techniques described by Zimmermann and Zimmermann (1981). We did not have any success using this method. Tadpoles that survived to metamorphose did so after a prolonged larval period (6+ months) and all had spindly front legs (Vojt, 1986).

We have produced healthy frogs by leaving tadpoles in with the adult to be transported to

bromeliads and fed by the female parent. Care must be taken to mist tanks gently so tadpoles will not be washed out of the bromeliads. This method is much more time efficient than hand rearing for these species and resulted in healthy, viable frogs. However, we still have seen a few cases of spindly leg syndrome even with parent reared frogs.

**Conclusions**

Using the techniques described in this paper, we have successfully bred the following species in captivity: *Dendrobates auratus, D. azureus, D. pumilio, D. reticulatus, D. speciosus, D. tinctorius, Epipedobates anthonyi, E. espinosai, E. tricolor, Phyllobates bicolor, P. lugubris,* and *P. vittatus* (others are now in the tadpole stage). These techniques, however, are in an on-going state of evolution and improvements as there is still much to be learned about the captive biology of dendrobatid frogs.

It is hoped that this paper will stimulate further interest in displaying and propagating dendrobatid frogs in other institutions. Although captive breedings of some species are becoming commonplace (*D. auratus, D. tinctorius*), many species reproduce infrequently (*D. pumilio*), and others have yet to reproduce, to our knowledge, in a United States zoo or aquarium (*D. granuliferus, D. histrionicus, D. lehmanni*). Many of these species, have, however, been frequently bred in European collections.

With the current unstable political relationships and "drug wars" occurring in many Latin American countries, numerous species of dendrobatid frogs may not be available from the wild for years to come. Rain forest destruction may mean some species will never be available again. Therefore, it is hoped that we will manage our living resources of captive dendrobatid

frogs wisely.

**Acknowledgments**

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## -New Literature-

We are expanding this section to include any paper on Dendrobatids which has not previously appeared in this section so you can see the full range of literature related to dendrobatid frogs. Where appropriate we will also be reprinting the abstracts to give the reader a better idea of what is included in the papers listed. If anyone has references, especially of type descriptions of frogs, which do not appear here we would welcome a literature citation or a photocopy of the article. Thanks.

Bainbridge, J. S., 1989, The frogs whose perspiration can kill. Smithsonian, 19(10): 70-77 (January). (Beautifully illustrated popular article about dart-poison frogs).

Crump, Martha L., 1972, Territoriality and mating behavior in *Dendrobates granuliferus* (Anura: Dendrobatidae). Herpetologica, 28(3): 195-198.

In Costa Rica *Dendrobates granuliferus* has definitive territorial behavior involving vocalization, posture, and combat. Only males defend territories. Males scout ahead for oviposition sites and lead females to these sites. Females have a uniform courtship behavior consisting of rubbing the head and chin of the male with her head. Oviposition and fertilization take place terrestrially while the frogs are in a vent to vent position, facing away from each other: there is no amplexus. Each female apparently lays several small clutches per breeding season.

Donnelly, Maureen A., 1989, Effects on reproductive resources supplementation on space-use patterns in *Dendrobates pumilio*.

Oecologia, 81: 212-218.

I increased the availability of tadpole-rearing sites (bromeliads) and oviposition sites (leaf litter) and examined the effects on space-use patterns in adult *Dendrobates pumilio* at the La Selva Biological Reserve in northeastern Costa Rica. I made 4158 observations of 986 marked adults during the seven-month study period. The addition of leaf litter did not result in increased density, but the addition of bromeliads did. The addition of leaf litter resulted in increased home-range size, but the effect depended on bromeliad addition and sex. Home-range size was greater for females than males, and may be related to parental care and/or mate selection. Home-range size was not correlated with density. Spatio-temporal overlap was not affected by resource supplementation but the proportion of females captured in sites shared with males varied temporally. Dispersion was not affected by bromeliad supplementation but males on litter-addition plots were less clumped than males on other plots. These results indicate that the density increase observed on bromeliad-addition plots was accommodated by frogs utilizing previously unoccupied space. Frogs were captured more frequently at bromeliads on bromeliad-supplemented plots than on litter-addition and control plots. The size of the area defended by territorial males is smaller than home-range size indicating the absence of home-range defense.

Duellman, William E. and Simmons, John E., 1988, Two new species of Dendrobatid frogs, genus *Colostethus*, from the Cordillera del Cóndor, Ecuador. Proceedings of the Academy of Natural Sciences of Philadelphia, 140(2): 115-124.

Two new species of *Colostethus* are described from the physiographically isolated Cordillera del Cóndor in southern Ecuador.

1873, which has not been recognized as a valid taxon since its original description; it is here removed from the synonymy of the common *D. auratus*. The only known specimen of *maculatus* is the holotype that was collected over a century ago, purportedly in "Chiriqui," which then included both Atlantic and Pacific sides of extreme western Panama. Except in color pattern, *D. maculatus* is a relatively pleisomorphic species that, unlike other Central American *Dendrobates*, retains maxillary teeth, finger 1>2, and vestigial foot webbing. Its closest relationships remain to be determined.

A pale-spotted pattern (yellow on black) also is autapomorphic in *Dendrobates vanzolinii*, new species, an easily recognized frog that occupies a fairly large range in east-central Peru and adjacent Brazil. Its range a t least partly overlaps that of *D. quinquevittatus* Steindachner, 1864, and some specimens of *vanzolinii* have been recorded under that name. Although *D. quinquevittatus* is indeed a widespread and variable species, it is nonetheless a composite of at least five species as currently recognized. *Dendrobates fantasticus* and *D. reticulatus*, both described by Boulenger ("1883" [1884]), have been wrongly placed in the synonymy of *quinquevittatus*.

A population sample assigned to *D. reticulatus* was obtained sympatrically with *D. quinquevittatus*; the specimens are readily distinguished by color pattern, body size, and size of hands and finger discs. A distinctive reticulated pattern on the limbs seemingly provides a synapomorphy that unites at least four Amazonian species, namely *quinquevittatus, fantasticus, reticulatus*, and *vanzolinii*, with the first species seemingly occur sympatrically with the last three. Color patterns are divergent in this monophyletic group, with *D. vanzolinii* being the only spotted species.

A fifth frog that has been mentioned in print under the name

*quinquevittatus* is *Dendrobates captivus*, new species, which is known only from three specimens collected by Harvey Bassler in 1924 and 1929, at the mouth of the Rio Santiago, 177 m (upper Rio Marañón), Department of Amazonas, Peru. *Dendrobates captivus* occurs sympatrically with *quinquevittatus*, from which it is easily distinguished by a lineate spotted pattern, nonreticulated limbs, and smaller hands. There is no demonstrably close relationship with the *quinquevittatus* group on the basis of present evidence.

The sister species of *captivus* may be *Dendrobates mysteriosus*, new species, from higher in the Marañón drainage (mountain forest NW mouth Rio Chinchipe, 900 m. elev., Dept. Cajamarca, Peru). This species is known from only a single specimen, also obtained by Harvey Bassler, in 1929. It differs from *captivus* in an irregular pattern of large spots, larger size, and larger hands. Points of resemblance include similarly spotted thighs and well-developed first digits of hands and feet (as compared with *quinquevittatus*).

Myers, Charles W. and Burrowes, Patricia A., 1987, A new poison frog (*Dendrobates*) from Andean Colombia, with notes on a lowland relative. America Museum Novitates, 2899: 1-17.

*Dendrobates andinus*, new species, is a small arboreal frog from wet montane forest (1700-2020 m elev.) on the Pacific versant of the Andes in extreme southwestern Colombia. Although its color pattern-yellowish dorsolateral stripes on a black or dark brown body-is reminiscent of two other Colombian species (*D. truncatus* and *Phyllobates aurotaenia*), *D. andinus* is not closely related to them. *Dendrobates andinus* is tentatively placed in the *pictus* species group, in which its closest relative seems to be *D. erythromos* Vigle and Miyata, from lowland rain forest (170 m elev.) on the Pacific side of

Ecuador. The recently described *"Phyllobates" azureiventris* Kneller and Henle, from Amazonian Peru, incidentally, is also transferred to the *pictus* group of *Dendrobates*.

Natural history data for *Dendrobates andinus* include observations on courtship behavior and cephalic amplexus; individuals are most frequently associated with water-filled bromeliads, where clutches of three or four eggs are laid. Sound spectrograms and waveforms of the advertisement call of *Dendrobates erythromos* are provided for future comparison when recording become available for *D. andinus*, whose call was perceived in the field as a series of well-spaced "crreek" notes. The call of *erythromos* is termed a *retarded chirp call* and is briefly compared with the characteristic chirp call of the histrionicus species group of *Dendrobates*.

Myers, Charles W. and Daly, John W., 1976, A new species of poison frog (*Dendrobates*) from Andean Ecuador, including an analysis of its skin toxins. Occasional papers of the Museum of Natural History, The University of Kansas (Lawrence, Kansas), 59: 1-12.

Describes the new species *Dendrobates abditus* from the lower montane rain forest (1700 m elevation) southwest of the Rio Azuela bridge on the Quito-Lago Agrio road, eastern base of Volcán Reventador, Napo Province, Ecuador.

Myers, Charles W. and Daly, John W., 1980, Taxonomy and ecology of *Dendrobates bombetes*, a new Andean poison frog with new skin toxins. American Museum Novitates, 2692: 1-23.

*Dendrobates bombetes,* new species, is a small, red-striped frog inhabiting the western Andes near Cali, Colombia. Nearest

relatives are the Ecuadoran *D. abditus* and the northern Colombian *D. opisthomelas*; these three Andrean species are considered a monophyletic unit of the "*minutus* group" because of a larval synapomorphy. The name *D. reticulatus* is resurrected from the synonymy of *D. quinquevittatus* for a small frog occurring sympatrically with *quinquevittatus* in Amazonian Peru.

*Dendrobates bombetes* was found in two forest types at localities separated by 30 km. distance and 800 m elevation. Differences in population structure suggest the possibility that either reproductive success or juvenile survivorship may be inversely density dependent. Cool montane forest islands supported dense, presumably stable populations having few juveniles and a high proportion of large (old?) adults. Marginal habitat in relatively xeric gallery forest supported a small population having significantly more juveniles and smaller (younger?) adults, suggesting rapid turnover in a precarious habitat. One or two tadpoles were carried by male nurse frogs, but free-living larvae were not found.

The call is a short, surprisingly loud and far-carrying, insect-like buzz influenced by ambient temperature. Rising temperatures cause pulse rate to increase and call length to decrease; the second effect probably reinforces the first, since there seems to be an independent tendency for short calls to be pulsed faster than long ones. The call of a related species, *Dendrobates opisthomelas*, differs even at the same temperature in duration, pulse rate, and dominant frequency.

Defensive skin secretions of *Dendrobates bombetes* contained 22 piperidine alkaloids in the two sample populations, with 15 or 17 compounds each. Interpopulational variation is partly due to minor differences in degree of saturation of some compounds, and the gas

chromatographic profiles are therefore much alike even though the shared-alkaloid value is low (67%). Three new alkaloids from at least a natural subgroup in the pumiliotoxin-A class, to which they are tentatively assigned in spite of anomalous mass spectra; a fourth new alkaloid is placed in the pumiliotoxin-C class.

Myers, Charles W., Daly, John W., and Martnez, Victor, 1984, An aboreal poison frog (*Dendrobates*) from western Panama. American Museum Novitates, 2783: 1-20.

*Dendrobates arboreus*, new species, is a small arboreal frog with a dorsal and ventral pattern of vivid yellow spots on a brown or black field. It is abundant at 1100-1300 m above sea level on a low section of the continental divide in western Panama, where, in undisturbed cloud forest, virtually the entire population resides high above ground on trees laden with bromeliads and other epiphytes. A few specimens also come from a locality in the adjacent Caribbean lowlands.

The pale-spotted color pattern of *Dendrobates arboreus* is similar to that of the enigmatic *D. maculatus*, also from western Panama, but these two species differ significantly in morphology and are not closely related. *Dendrobates arboreus* is assigned to the *histrionicus* species group, which includes two species occurring macrosympatrically with *arboreus*, *D. speciosus* (highlands) and *D. pumilio* (lowlands). The morphology of the *histrionicus* group is indicated by very similar-sounding chirp calls-given as long trains of harsh notes that differ among species in rate of note repetition, not duration, and dominant frequency. New spectrographic analysis of pulse rates compels a restatement of Myers and Daly's original distinction between chirp calls and buzz calls, two important classes

of dendrobatid vocalizations.

Courtship and egg laying of *Dendrobates arboreus*, and cannibalism of eggs by an adult female, were observed in captivity. There is no amplexus during mating, although typical cephalic amplexus (primitive within the Dendrobatidae) is retained in the behavioral repertory, possibly in an aggressive context. Courtship includes tactile signals by both sexes prior to their assuming a vent-to-vent position for egg laying and fertilization. An instance of mate piracy was observed when a second male successfully intruded at a late stage of courtship, bypassing the preliminary tactile signaling of the original pair.

Defensive skin secretions of *Dendrobates arboreus* contained 14 piperidine alkaloids, including members of the pumiliotoxin-A class and its allopumiliotoxin-A subclass. Remaining alkaloids, including two new compounds, are left unclassified. Histrionicotoxins were not detected.

Silverstone, Philip A., 1975, A revision of the poison-arrow frogs of the genus *Dendrobates* Wagler. Natural History Museum of Los Angeles County, Science Bulletin 21: 1-55.

The bone and thigh and jaw muscles of 14 of the 16 known species of *Dendrobates*, 15 of the 20 known species of *Phyllobates*, and 12 of the more than 40 known species of *Colostethus* were examined. All species examined (including *C. bocagei*, which has been reported to have a "ranid" thigh muscle pattern) have a "dendrobatid" thigh muscle pattern (the distal tendon of insertion of the *semitendinosus* muscle pierces that of the *gracilis major* muscle). Dendrobatids also differ from ranids in lacking the *adductor mandibularis externus superficialis* (one of the jaw muscles). Only

tow species of dendrobatids (*D. histrionicus* and *D. leucomelas*) lack an omosternum. Most species of dendrobatids lack palatine bones; of the species examined, only two (*Colostethus palmatus* and *C. trinitatis*) have palatine bones. Most specimens of *Dendrobates* examined have some of the vertebrae fused. Most specimens of the other two genera lack such fusion.

The genus *Dendrobates* consists of 16 species, including two new species from the Chocoan region of Colombia (*D. altobueyensis* and *D. fulguritus*). Species of *Dendrobates* are placed in four groups: (1) *histrionicus* group (*D. histrionicus, D. leucomelas*); (2) *minutus* group (*D. altobueyensis, D. fulguritus, D. minutus, D. opisthomelas, D. quinquevittatus, D. steyermarki*); (3) *pumilio* group (*D. granuliferus, D. pumilio, D. speciosus*); (4) *tinctorius* group (*D. auratus, D. azureus, D. galactonotus, D. tinctorius, D. truncatus*). It is proposed that five species (D. *bassleri, D. ingeri, D. parvulus, D. pictus,* and *D. trivittatus* ) be transferred from *Dendrobates* to *Phyllobates*.

Dendrobatids probably arose in South America after the beginning of Eocene and entered Central America in Pliocene. *Dendrobates* probably invaded Central America in three waves. The present distribution of the lowland species of *Dendrobates* is limited principally by rainfall and associated plant formations, and is correlated with Haffer's Pleistocene interglacial humid refuges. Four species of *Dendrobates* probably arose in Central America and 12 in South America. The principal component of the diet of *Dendrobates* in ants. Descriptions, collecting localities, and range maps are given for each species of *Dendrobates*. Illustrations depict 15 species, nine of them in color.

Silverstone, Philip A., 1976, A revision of the poison-arrow frogs of

the genus *Phyllobates* Bibron *in* Sagru (Family Dendroatidae). Natural History Museum of Los Angeles County, Science Bulletin 27: 1-53.

The 20 diurnal, terrestrial, mostly forest-dwelling species of the anuran genus *Phyllobates* occur from Costa Riva to Brazil' half of the species inhabit the Amazon drainage.

The distinction between *Colostethus* (dorsum dully colored and skin toxins presumably absent) and *Phyllobates* (dorsum brightly colored and skin toxins presumably present is maintained. Finger length and finger disk size are used herein to distinguish *Dendrobates* (first finger shorter than second, and finer disks relatively large) from *Phyllobates* (first finger equal to or longer than second, and finer disk relatively small) instead of the traditional character, absence (*Dendrobates*) or presence (*Phyllobates*) of teeth, although the tooth character is still useful. Using finer length and finger disk size as a definition, five species (*bassleri, ingeri, parvulus, pictus*, and *trivittatus*) transfer from *Dendrobates* to *Phyllobates*.

*Phyllobates* includes four species groups: (1) *bicolor* group (*Phyllobates* species [to be described by C. W. Myers and J. Daly], *P. aurotaenia, P. bicolor, P. lugubris, P. vittatus*); (2) *femoralis* group (*P. anthonyi, P. boulengeri, P. espinosai, P. femoralis, P. tricolor, P. zaparo*); (3) *pictus* group (*P. bolivianus, P. ingeri, P. parvulus, P. petersi, P. pictus, P. pulchripectus, P. smaragdinus*); (4) *trivittatus* group (*P. bassleri, P. trivittatus*). Four new South American species are described herein: *Phyllobates petersi, P. pulchripectus, P. smaragdinus*, and *P. zaparo*.

The life history of *Phyllobates* (insofar as it is known) resembles that of its relatives *Dendrobates* and *Colostethus*. *Phyllobates* usually oviposits (at least in one species, and probably in all species, without

amplexus) on leaves. After the tadpoles hatch, a parent carries them on its back and releases them in water, where the tadpoles complete their development. In at least some species, either the male parent or the female parent may carry the tadpoles. The main food of Phyllobates in ants.

Amerindians extract blowgun poison from at least two species (*P. aurotaenia* and *P. bicolor*).

Tawa, Audrey, 1990, Pretty Poison. Zoo Life, 1(2): 14-15. (Short look at the Baltimore Aquarium captive breeding program with nice pictures of *D. histrionicus* and *D. azureus*).

Wagner, Ernie, 1987, Breeding arrow poison frogs and looking for ways to reduce the labor. Captive propagation and husbandry of reptiles and amphibians. Northern California Herpetological Society, Special Publication 4: 11-16.

Wells, Kentwood D., 1978, Courtship and parental behavior in a Panamanian poison-arrow frog (*Dendrobates auratus*). Herpetologica, 34(2): 148-155.

Courtship and parental behavior of *Dendrobates auratus* were studied in the field and in captivity. Males are nonterritorial, but occasionally engage in aggressive competition. Males call to attract (female female) and lead them to oviposition sites in leaf litter. Courtship includes elaborate tactile interactions between partners, with the (female) taking the more active role. Parental care is performed by the male and includes tending the eggs and transport of tadpoles to water. Males can care for >1 clutch simultaneously. High male parental investment may lead to a shortage of (male male),

limiting (female) reproductive success. This may result in inter female competition and a partial reversal of the usual sex roles in courtship. [Editors note: In the abstract symbols were used to denote male and female in several cases. These signs are replaced here in parentheses (to be easily recognized) as the symbols for male and female are beyond our printing ability at this stage].

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## IHS #14: Dallas-Ft. Worth, Texas June 20-23, 1990

by Ed Osaben

A Dendrobatid workshop was held on June 20th at the 14th Annual International Herpetological Symposium, hosted by the North Texas Herpetological Society of co-sponsored by the Dallas Zoo and Ft. Worth Zoological Park. Richard Zerilli, Department of Herpetology, New York Zoological Society, presented a slide program detailing the new dendrobatid breeding program and exhibit at the Bronx Zoo. Some of the dart-poison frogs he is currently working with are *Dendrobates tinctorius, D. azureus, D. histrionicus, D. auratus, Phyllobates bicolor*, and *P. vittatus*. A recently opened exhibit features *P. bicolor* and *Bothriechis schlegelii* (Eyelash Vipers). After five weeks together the vipers have shown no interest in the frogs which are captive bred and thus non-toxic. The *P. bicolor* have been laying eggs but searching out the eggs can be quite a challenge with the vipers lurking nearby. Most of the other dart-poison frogs

were acquired as sub-adults and not of breeding age.

Following Richard Zerilli, a short slide program featuring a tadpole brooding designed and built by this author was presented. Inspiration for the design of the European style brooder came from an article by Ernie Wagner in the 1987 Northern California Herpetological Society Conference Proceedings, titled "Breeding arrow frogs and looking for ways to reduce labor" and also Erik Wever's presentation at IHS #13 in Phoenix, Arizona. The all glass brooder is approximately 42"x16"x9" deep. It has a capacity of 54 tadpoles with the chambers adjusted to the dimensions of 3.25"x2.66"x4" deep. Water is circulated by a power filter head with the flow adjusted through a PVC spigot. Filtration is accomplished in the lower 4.5" of the 42"x16" tank with a bed of filter floss and activated charcoal. The water temperature is maintained at about 78°F and an airstone is used to aid the aerobic biologic filtration.

Past ISSD President Dave Hulmes shared some slides of dart-poison frog tadpoles with severe gas bubbles and some with the all to familiar spindly leg syndrome. These problems opened the floor to an hour long discussion of the nutritional requirements of dart-poison frogs and their tadpoles. James Marlett of the Sedgewick County Zoo in Wichita, Kansas, reported that by supplementing the pinhead cricket diet of their dart-poison frogs three time a week with Nekton-Rep and two times a week with calcium they have successfully rid their breeding program of spindly leg. In the year prior to this success, 100% of their froglets developed spindly legs.

An annual ISSD meeting was not held in conjunction with this years IHS, as has been the case the previous two years.

# Announcements

The Society for the study of Amphibians and Reptiles conviened a symposium on the "Global crisis in declining amphibian diversity" at this years joint meeting of the SSAR and Herpetologists' League in New Orleans. They are seeking contribution to help defer the costs of this symposium. If anyone is interested in contributing please contact Dr. Douglas Taylor, Department of Zoology, Miami University, Oxford, OH 45056. Thanks.

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# -Want Adds-

Ed Oshaben (10669 Jubilee Dr., Chardon, OH 44024 Tel.: (216) 285-9215). *Dendrobates auratus*, F2 captive bred from National Aquarium Costa Rica stock, 3/4" juveniles, $20.00 each or will consider trade for other frogs.

VIDEOTAPES

(also available from Ed Oshaben)

1990 Dendrobatid Worshop from the IHS #14, Dallas-Ft. Worth, Texas (see report in this issue). $20.00 including postage for VHS or 8 mm video.

1989 ISSD Workshop for IHS #13, Phoenix, Arizona. "Captive husbandry & breeding of Dendrobatid frogs" by Eric Wevers (Holland) plus "Construction of Terrarium environments suitable for amphibians" by Dale Bertram, M.D (USA). 120 minutes. $20.00 including postage for VHS or 8 mm video (2 European VHS available for $35.00 each).

1988 ISSD Workshop for IHS #12, Newark, New Jersey. (see Volume 1, no. 4 ISSD Newsletter for full description of video). 90

minutes. $15.00 including postage for VHS or 8 mm video.

Charles Powell, II (2932 Sunburst Dr., San Jose, CA 95111 USA). I'm interested in trading photocopies of American Dendrobatid literature for the same from the European literature. I am especially interested in papers describing new species of *Dendrobates* and *Phyllobates*. If anyone is interested please send a list of what you have available and/or what you are looking for. I am also still looking for *Dendrobates reticulatus* if anyone has them available.

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## -Errata-

In the first issue of this volume [3(1)] the editors left out part of the last paragraph of Charles Fenzlaw comments on cross breeding dendrobatid frogs. Because of space limitations only the last paragraph will be reprinted here. For the full article please refer to ISSD Newsletter, 3(1): 14-15.

If crossbreeding is the desire of the keeper than certain factors should be considered. First, why do you want to cross these animals? Is it to verify a possible link between species? Is it to possibly promote a stronger species of frog (one that is more adaptive and can be kept easier than the pure breed of either species)? Or are you just doing it to see what happens? The first two reasons I consider reasonable. I believe there is much that could be learned regarding the links between species by knowing if two species will mix and if the offspring are fertile. The third reason for cross breeding is a bit selfish to say the least. Arbitrary crossbreeding should be avoided unless you are willing and able to keep the offspring separated from the main

colonies and maintained them throughout their lives. If these cross bred frogs are sold to anyone it is your responsibility to inform the purchaser exactly what you are selling. I do not intend to cross breed my frogs for the simple fact that there are too many species that I wish to work with, let alone to breed successfully. Also I believe that mixing of *Dendrobate* species in a captive environment is counter productive. If we are trying to give the most natural setting possibly to induce breeding how can putting two species together, which may never encounter each other in the wild, be anything but a negative influence. To conclude I do not believe cross breeding is necessary for the average hobbyist. However those who have a scientific interest in dendrobatids may find out something that was unknown before.

Charlie Fenzlaw

## Breeders Forum

We would like to reinstate this section as a forum for the exchange of information to help us all better keep our frogs.

I would like to let everyone know that I have found Magnolia leaves serve as excellent cover for frogs in my tanks. The leaves are smooth, large, generally long lasting and easily collected under any magnolia tree (which are common in California).

Charles L. Powell, II

shaded colors present (blue, black, yellow, and white).

This species has been reported from lowland forests in Guyana, French Guyana, Suriname and adjacent Brazil and from elevations near sea level to 300 m, although one record reports it from over 600 m in Guyana (Silverstone, 1975).

**ISSD invites anyone with an interest in the study of Dendrobatid Frogs to participate in its membership.**

## Membership Registration:

**Name:** _____

**Address:** _____

_____

_____

_____

**Phone #:** _____

**Date:** _____

**Comments:** _____

Annual membership dues are as follows: $20.00 for members living in the U.S.A. and Canada; $25.00 for members living in Europe and South America. For members holding a personal checking account with a U.S. bank - a personal check (made out in U.S. dollars and made payable to **ISSD**) will suffice. For those who do not have an account with a U.S. bank - payment should be made using one of the following methods (listed in order of preference): *1.)* A U.S. Postal Money Order made out in U.S. dollars. *2.)* A Casher's Check from a U.S. bank, or U.S. affiliate of a non-U.S. bank, made out in U.S. dollars. *3.)* A Casher's Check from a non-U.S. bank, made out in the normal currency of the bank of issue, for an amount which will yield $28.00 when it is exchanged. *4.)* Cash -U.S.$, wrapped well so that it cannot be seen through the envelope, and sent via Registered Mail.

Send registration forms and dues to:

**ISSD** - c/o Ed Tunstall
2320 West Palomino Drive
Chandler, Arizona
85224 U.S.A.